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DRAFT
BIOVENTING TEST WORK PLAN FOR BUILDING 818 UST FUEL RELEASE SITE LANGLEY AFB, VIRGINIA

Prepared for:

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BROOKS AFB, TEXAS

and

HEADQUARTERS ACC-1ST FIGHTER WING
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April 1994

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BIOVENTING TEST WORK PLAN FOR BUILDING 818 UST FUEL RELEASE SITE LANGLEY AFB, VIRGINIA

1.0 INTRODUCTION

This site-specific work plan presents the scope of a bioventing pilot test for *in situ* treatment of fuel-contaminated soils at Building 818, Langley Air Force Base, Hampton, Virginia. The proposed test site is a former leaking #2 fuel oil underground storage tank (UST) located adjacent to Building 818 in a base family housing area. Existing site assessment data was evaluated and it was determined that the Building 818 site is suitable for a bioventing pilot study. Although the base is currently evaluating additional sites to include in the bioventing pilot test program, a second pilot test site has not been identified to date. For this reason, this work plan focuses exclusively on the Building 818 test site. If a second pilot test site is selected, the test protocols and field procedures described in this work plan will apply to both bioventing test sites.

1.1 Pilot Test Objectives

The proposed bioventing pilot test has three primary objectives: 1) to assess the potential for supplying oxygen throughout the contaminated soil depth, 2) to determine the rate at which indigenous microorganisms will degrade the fuel when stimulated by oxygen-rich soil gas, and 3) to evaluate the potential for sustaining these rates of biodegradation until fuel contamination is remediated below regulatory standards. If bioventing proves to be a feasible technology for the site, pilot test data will be used to design a full-scale remediation system and to estimate the time required for remediating soils to regulatory standards. An added benefit expected at the pilot testing site is that a significant amount of fuel contamination should be biodegraded during the test, since the testing will take place within the most contaminated soils that have been detected on the site.

The pilot test at Building 818 will involve one horizontal air injection well, one horizontal soil vapor extraction (SVE) well, and a blower capable of sustaining a flow rate of at least 30 standard cubic foot per minute (scfm). The effective radius of oxygen influence for horizontal vent wells operated in areas with a shallow water table is typically more limited compared to systems utilizing vertical vent wells at sites with a deeper water table. Previous bioventing experience at test sites with conditions similar to Langley AFB indicates that a radius of oxygen influence of 20 to 25 feet is reasonable using horizontal vent wells operated at low to moderate air injection rates. The design flow rate and actual radius of influence for a specific site will depend on soil properties, depth to groundwater, and other factors.

Rates of *in-situ* oxygen utilization will be measured during respiration tests conducted at individual soil vapor monitoring points installed around the venting wells. Several existing groundwater monitoring wells will also be used for this purpose. The

oxygen utilization data will be used to determine a fuel biodegradation rate for each vapor monitoring point.

Additional background information on the development and recent success of the bioventing technology is found in the document entitled "Test Plan and Technical Protocol For A Field Treatability Test For Bioventing." This protocol document is a supplement to the site-specific work plan and it will also serve as the primary reference for pilot test designs and detailed test objectives and procedures. Unless otherwise noted, test procedures outlined in the protocol document will be used during the bioventing pilot tests at Langley AFB.

2.0 SITE DESCRIPTION

This section provides a brief description of the site conditions at Building 818. Information summarized herein was derived from previous site assessment reports and other pertinent information provided by Langley AFB. This discussion centers entirely on the Building 818 site since it has been selected for bioventing. Data from other sites will be evaluated to determine the appropriateness of a potential second site for bioventing.

2.1 Building 818 UST Fuel Release Site

2.1.1 Site Location and History

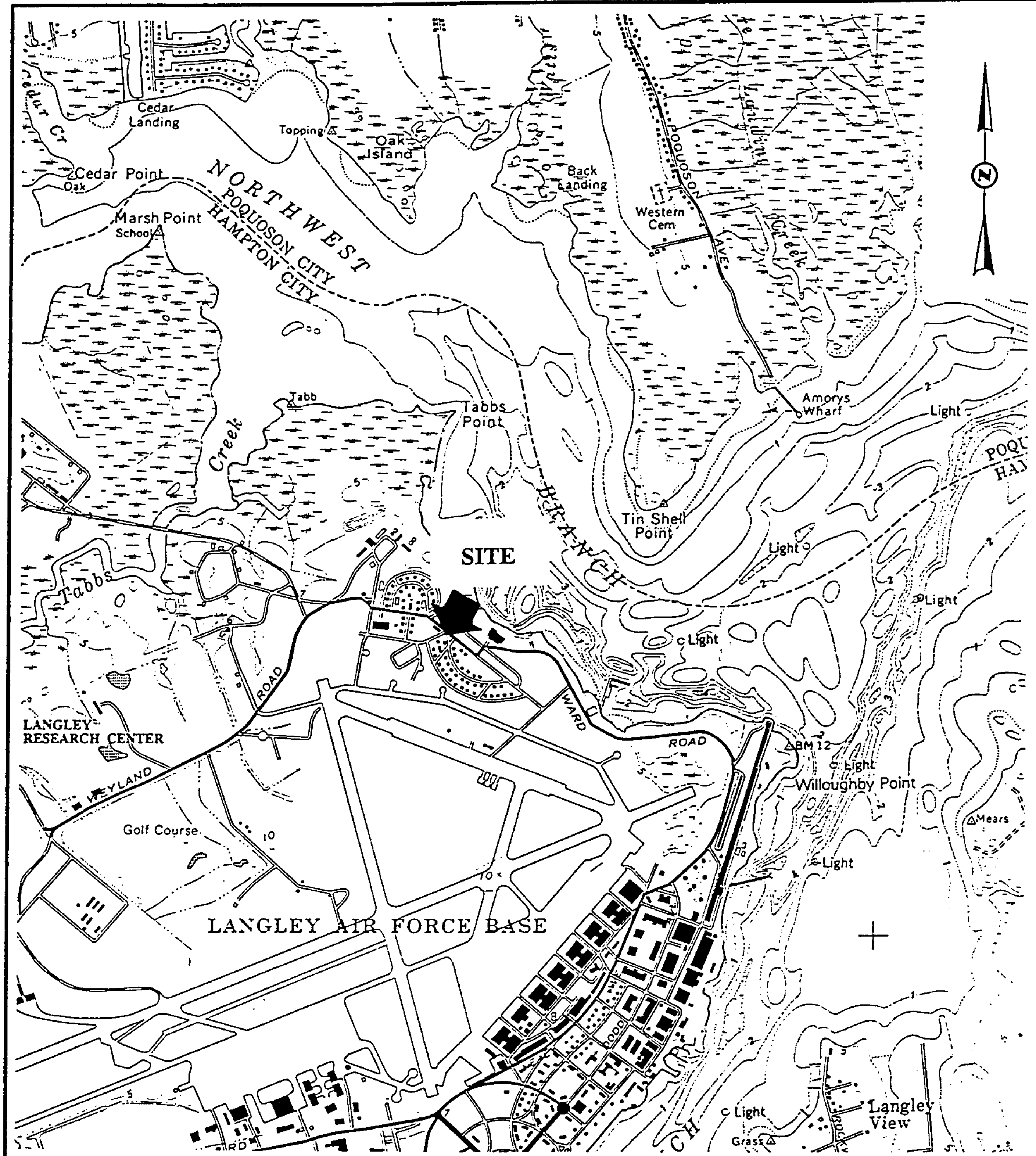
Building 818 is a two-story duplex located in an on-base residential housing area for Air Force personnel and their families. The building is located on the northeastern part of the base near the intersections of Hilliard Street, Harris Avenue, and Helms Avenue. Figure 2.1 shows the general location of the site with respect to the base. Other base residences are located adjacent to Building 818, including Buildings 819 and 815. All of these residential buildings reportedly have a full basement beneath the main structures. The area proposed for bioventing is located in a yard on the north side of Building 818. Figure 2.2 shows a site plan with monitoring well locations for Building 818 and surrounding structures.

Historically, the residential housing units in this area used #2 fuel oil stored in USTs for heating purposes. The UST previously located on the north side of Building 818 had a reported capacity of 1,000 gallons. According to base records, the age of the former UST at Building 818 is greater than 60 years. The UST failed a tank tightness test and the subsequent environmental site assessment revealed that soil and groundwater were impacted by petroleum hydrocarbons (see section 2.1.2 below).

2.1.2 Previous Investigations

After the Building 818 UST failed the tank tightness test, the remaining fuel oil was immediately removed. PetroChem Recovery Services, Inc. (PetroChem) of Norfolk, Virginia was subsequently retained to perform a site investigation to determine the magnitude and extent of the fuel oil release(s) at Buildings 818 and 819. Petrochem installed and sampled 8 shallow groundwater monitoring wells screened across the water table in the vicinity of Building 818. Split spoon soil samples were collected from the monitoring well soil borings and analyzed for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylenes (BTEX). Generally, the soil samples analyzed for TPH were collected from depths of about 6 to 8 feet below

Figure 2.1



2000 1000 0 2000'

Approximate Scale in Feet

From: U.S.G.S. Hampton, VA Quadrangle
(7.5 Minute Topographic Map – Revised 1986)

Site Location Map

Building 818
Langley AFB
Hampton, Virginia

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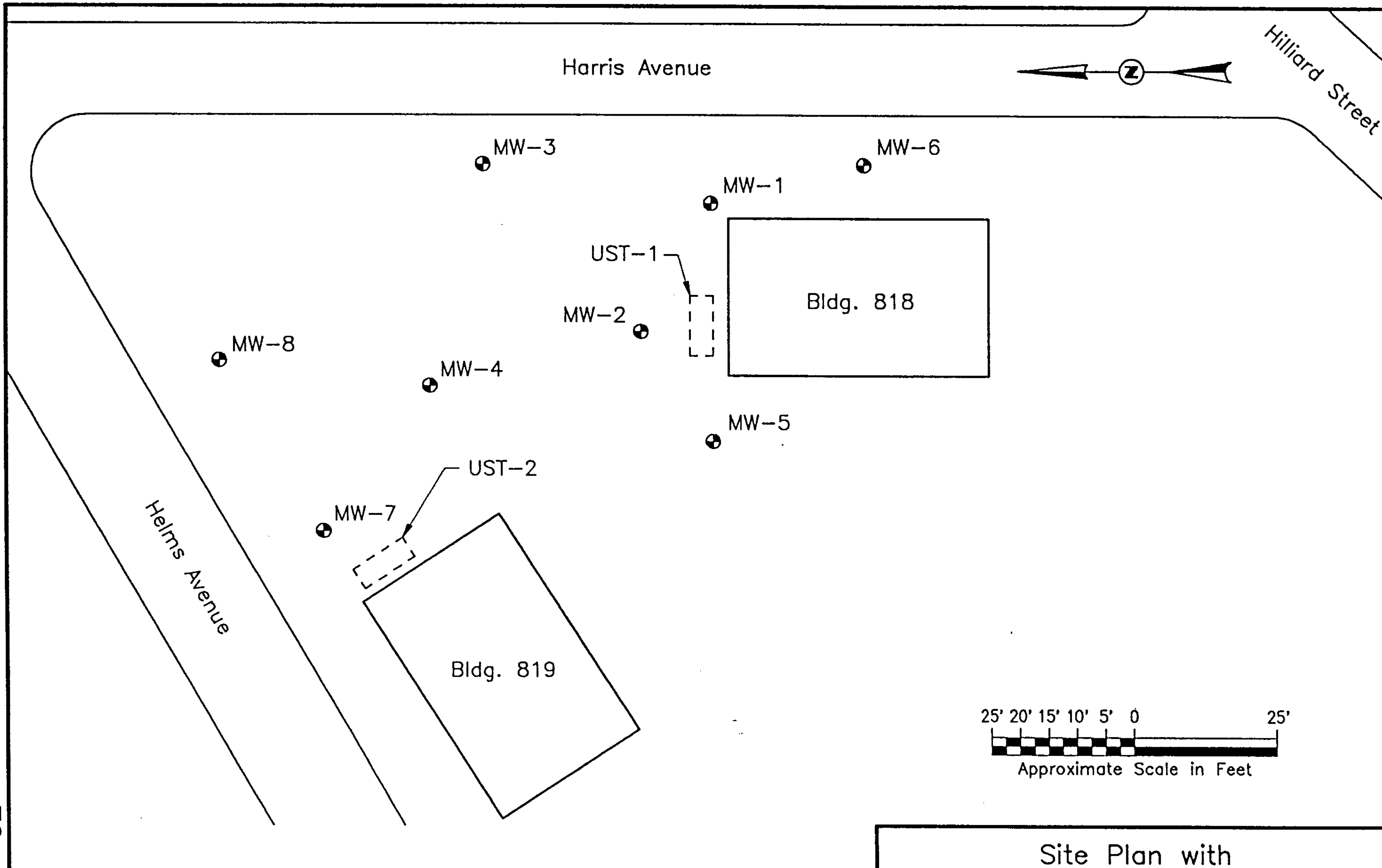


LEGEND

MW-1 Monitoring well.

Former location of underground storage tanks.

Map Sources:
PetroChem Recovery Services (9/24/93); and Environmental Technology of North America, Inc. (3/24/94)

Site Plan with Monitoring Well Locations

Building 818
Langley AFB
Hampton, Virginia

Figure 2.2

ground surface (bgs). This corresponds to the approximate depth of the water table surface, or just below it, at the time of sample collection.

Results of PetroChem's site assessment indicated that soils and groundwater have been impacted at Building 818. Soil TPH concentrations ranged from no detection at MW-3 to 3,080 milligrams per kilogram (mg/kg) at MW-1. BTEX compounds were also detected in the soil samples, generally less than 1 mg/kg for each compound. Groundwater samples also contained TPH and BTEX compounds. Aqueous samples from well MW-1 contained 2.16 milligrams per liter (mg/L) of TPH and 28.2 micrograms per liter (μg/L) of total BTEX. Benzene is present in groundwater at 14.4 μg/L at well MW-1. Petrochem reported that the soils contained a non-aqueous phase liquid product ("free product") as an emulsified oily sheen. Liquid-phase product has not been detected in measurable accumulations in the monitoring wells (PetroChem, 1993).

The empty UST at Building 818 was removed in January, 1994 under the supervision of Environmental Technology of North America, Inc. (ETNA) of Greensboro, North Carolina. ETNA reported that the UST was heavily corroded and contained numerous small holes. Two soil samples were collected from beneath each end of the UST at a depth of 8 feet bgs. The soil samples were analyzed for total recoverable petroleum hydrocarbons (TRPH) by EPA Method 418.1. Analytical results showed that TRPH concentrations range from 9,400 mg/kg to 11,300 mg/kg. ETNA reportedly excavated only enough soil to remove the tank. The soil excavation dimensions were reported as 4 feet wide by 12 feet long by 8 feet deep (ETNA, 1994).

2.1.3 Site Geology and Hydrogeology

Langley AFB is located in the lower Coastal Plain physiographic province of southeastern Virginia. Sediments beneath the Base are characterized as a thick sequence of unconsolidated, interbedded sands, silts, and clays that dip and thicken toward the southeast. The subsurface stratigraphy originated primarily from fluvial-estuarine, lagoonal, marine, and tidal depositional processes. These interbedded layers are grouped into regional formations and aquifers based on lithologic and water quality characteristics. Surficial soils around the base are generally sandy and highly permeable at shallow depths, but may contain zones of clay and organic deposits. The base is marked by low geomorphic relief and is generally less than 10 feet above mean sea level.

The shallow stratigraphy at Building 818 consists of sands, silts, and clays of the Columbia Aquifer. The Columbia Aquifer forms the surficial, unconfined aquifer throughout the region. Soil boring logs from Building 818 indicate that the upper 6 to 8 feet consist of a brown to yellow-brown slightly clayey to silty sand locally containing gravel and shell fragments. Below this zone to a depth of at least 12 feet is a grey, silty fine-to-medium sand (PetroChem, 1993).

Groundwater is encountered at a depth of approximately 5 to 6 feet below ground surface (bgs) at Building 818. Locally, groundwater flows north-northeast toward Northwest Branch of Back River at an estimated linear velocity of 8 feet per year (PetroChem, 1993). Seasonal water table fluctuations of 1 to 2 feet are common in this area and recharge to the surficial aquifer from precipitation events is rapid. Northwest Branch of Back River is located approximately 1000 feet northeast of Building 818.

The proximity to Back River and the Chesapeake Bay creates a tidal zone influence in the tributaries around the base. It is unknown if shallow groundwater at Building 818 is influenced by short-term tidal fluctuations in the river.

A 4-inch diameter horizontal air injection well, a 4-inch SVE well, and four vapor monitoring points will be installed above the water table as part of the pilot study. Existing groundwater monitoring wells MW-1 and MW-2 will be used as soil vapor monitoring points if sufficient screen is exposed above the water table during the field testing activities. The 4 additional soil vapor monitoring points will potentially be installed at multiple depths to study the subsurface oxygen distribution pattern during the pilot test. Because the bioventing technology is applied to the unsaturated soils, this study will primarily address soils above the shallow water table. As the water table declines on a seasonal basis, more soil will be exposed for bioventing treatment at this site.

2.1.4 Site Contaminants

The primary contaminants at Building 818 are petroleum hydrocarbons associated with #2 fuel oil. Petroleum hydrocarbons have been detected in the soils and groundwater at depths ranging from about 6 to 12 feet bgs. TRPH maximum concentrations of 11,300 mg/kg were detected in soil sample LSS2 at a depth of 8 feet on the west end of the UST excavation (ETNA, 1994). This sample was likely collected below the water table surface. Soil samples collected from MW-1 at a depth of 6 feet contained 3,080 mg/kg of TRPH. This soil sample was collected just above the water table surface. Field soil headspace VOCs were also detected in concentrations of 94.6 parts per million (ppm) at this sampling point. Low concentrations of volatile organic BTEX compounds were detected in both soils and groundwater at the site. Emulsified liquid-phase product is present in the soils but it has not been manifested as a measurable accumulation in the adjacent groundwater monitoring wells.

The Langley AFB point of contact (Mr. John Ballinger) reports past problems with accumulation of fuel oil vapors in the basement of Building 818. The basement floor is positioned below the water table elevation and it has an operating sump pump to remove water seepage. Base health and safety personnel have monitored the basement and collected ambient air samples for quantitative analyses. The base reports that fuel vapor concentrations in the basement are very low and have not exceeded levels of health and safety concern. As discussed in the following sections, the bioventing pilot test design provides engineering controls to remove fuel vapors from subsurface soils in the vicinity of the basement. Additionally, a program of ambient air monitoring in the basement and outside the basement is proposed to demonstrate the effectiveness of the bioventing system to also provide vapor control.

3.0 SITE SPECIFIC ACTIVITIES

This section describes the proposed location of the air injection vent well, SVE well, and vapor monitoring points at Building 818. Soil sampling procedures and the blower configuration that will be used to both inject air (oxygen) into and remove vapors from contaminated soils are also discussed in this section. The conceptual bioventing test design and field sampling activities described in this section will be applied to all sites

selected for the bioventing pilot tests. Minor modifications to the vent well and MP configurations may be necessary to suit site-specific conditions.

Pilot test activities will target unsaturated soils remediation. Existing site monitoring wells will be used as supplemental soil vapor monitoring points (MPs) if there is sufficient screened interval across the water table. Additionally, existing uncontaminated monitoring wells that have a portion of their screened interval above the water table may be used to measure the composition of background soil gas. If an existing monitoring well does not meet this criteria, then a background vapor MP will be installed upgradient of the study area.

3.1 Bioventing Test Design For Building 818

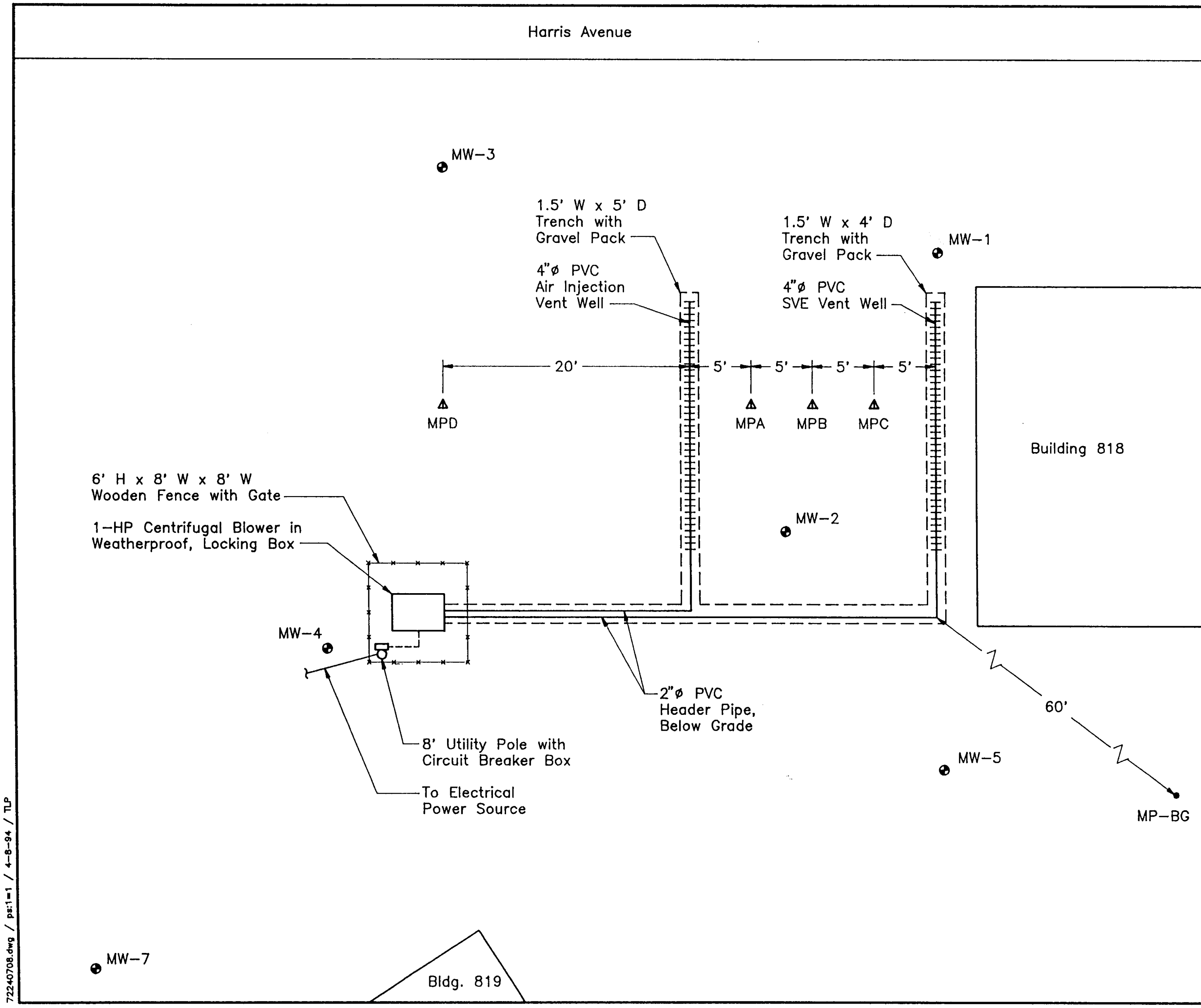
A general description of criteria for siting the horizontal soil venting wells and vapor MPs are included in the attached protocol. The system design for Building 818 is modified from the standard protocol in that a "closed loop" soil ventilation system is proposed. Using a single blower, the system will remove soil vapors via a shallow horizontal SVE vent well and then reinject a dilute mixture of extracted soil gas and atmospheric air into the soils via a horizontal air injection vent well. Recirculation of extracted soil gas through the subsurface will provide biodegradation of vapor-phase contaminants by using the soil mass as an *in situ* biofilter. Low concentrations of volatile-fraction fuel vapors are anticipated because the contaminant source is #2 fuel oil. Figure 3.1 illustrates the proposed locations of the horizontal air injection vent well, the horizontal SVE vent well, and soil vapor MPs at the site.

Both horizontal vent wells will be installed in narrow trenches excavated in contaminated soils just above the water table. The air injection vent well will be installed slightly deeper than the SVE vent well since water accumulation will not be a concern on the pressure side of the blower. The proposed depth of the air injection vent well is estimated as 5 feet bgs, while the estimated depth of the SVE vent well is 4 feet bgs. The final depths may be modified based on field conditions encountered at the time of system installation. Orientation of the vent well trenches will be approximately east-west as shown in Figure 3.1. The final locations of these wells may vary slightly from the locations shown in Figure 3.1 if significant fuel contamination is not observed during trenching activities.

Based on site investigation data, the horizontal air injection and SVE wells should be located on either side of existing well MW-2 and extend east toward MW-1. This is the general location of the former UST and this area is expected to have an average TPH concentration exceeding 3,000 mg/kg in unsaturated soils. Existing monitoring wells MW-1 and MW-2 will be utilized in addition to the four vapor monitoring points since these wells reportedly have about 2 to 2.5 feet of screen above the water table surface. Soils around these wells have the greatest potential of being oxygen depleted and increased biological activity should be stimulated by oxygen-rich soil gas ventilation during full-scale operations.

Considering the shallow depth of contamination of unsaturated soils at this site (< 6 feet bgs), the soil lithology, and the venting well configurations and operations required to accommodate shallow water table conditions, the radius of oxygen influence around the horizontal air injection well is expected not to exceed 25 feet. Installation of a

Figure 3.1



LEGEND

MW-1 ● Monitoring well.

MPA ▲ Proposed soil vapor/pressure monitoring point.

MP-BG • Proposed background monitoring point.

Note:

1. Final location of bioventing system may vary from the location shown. The relative configuration of vent wells and monitoring points will remain unchanged.

8' 4' 0 8'

Approximate Scale in Feet

Proposed Vent Well and Monitoring Point Locations

Building 818
Langley AFB
Hampton, Virginia

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horizontal SVE vent well adjacent to the building is expected to minimize air short-circuiting at the ground surface, as well as controlling soil vapor migration. The operating SVE vent well will create a zone of negative pressure, thereby inducing a preferred radial flow toward the SVE well and minimizing the vertical short-circuiting potential. The SVE vent well will provide both soil vapor control and extraction from around the building foundation. Vapor-phase hydrocarbon accumulation is not expected to be a major factor since the contaminant source is a #2 fuel oil.

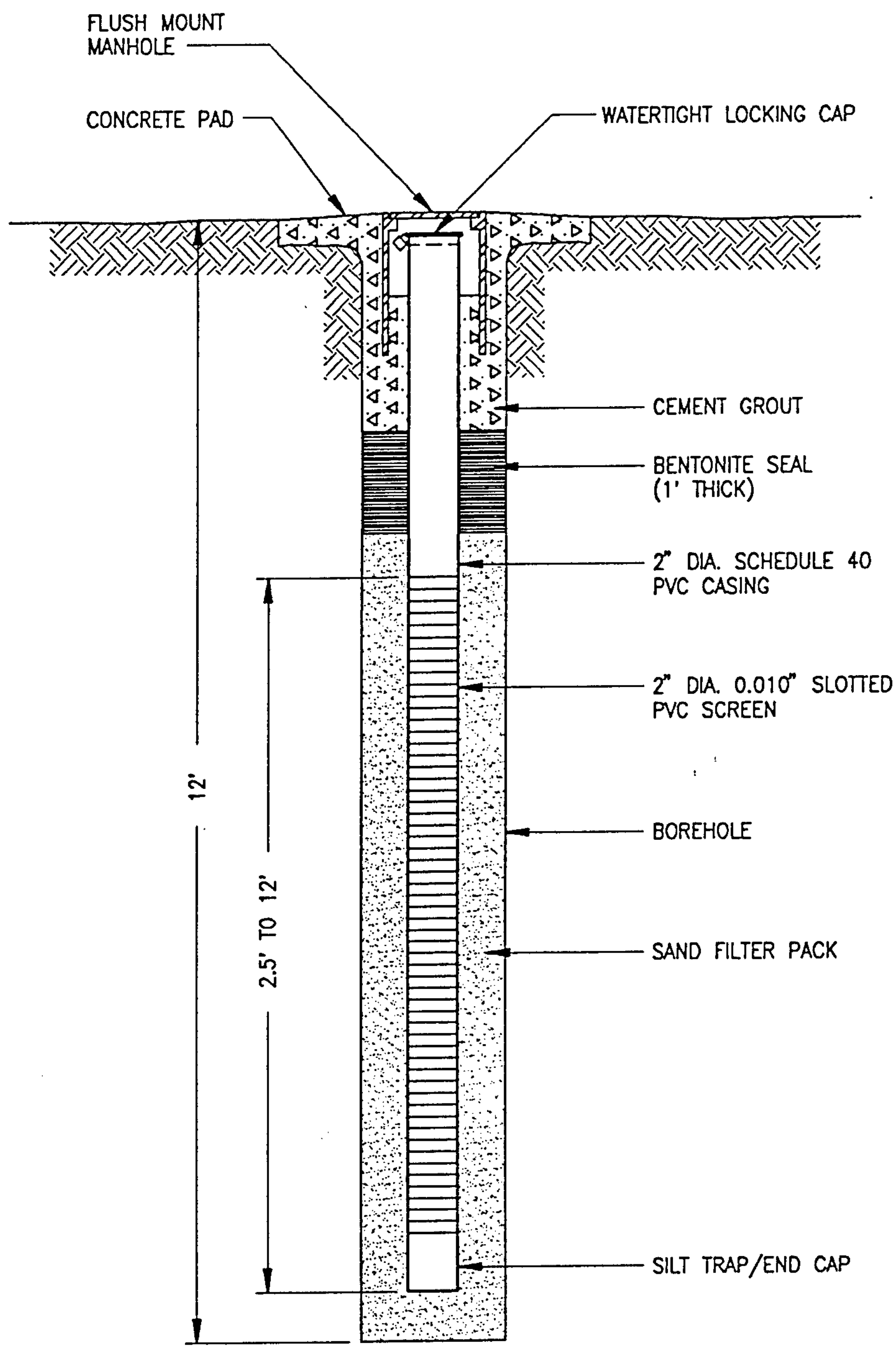
Four MPs will be located within a 20-foot radius of the air injection vent well. As depicted in Figure 3.1, three of the MPs will be placed in a straight line on 5-foot centers between the air injection and SVE vent well trenches. The fourth well will be placed 20 feet north of the air injection vent well. An effort will be made to use an existing monitoring well to measure background levels of oxygen and carbon dioxide and to determine if natural carbon sources (i.e. organic layers) or abiotic reactions are contributing to oxygen uptake during the *in situ* respiration tests. According to previous site assessment results, this may not be possible since all of the well sampling points have detected either soil or groundwater contamination. If no suitable existing well is available, a background MP will be constructed in clean soils upgradient of the site.

Existing groundwater monitoring wells may be temporarily converted to vapor MPs for conducting respiration tests and air permeability tests. At Building 818, wells MW-1, MW-2 and MW-3 may be most suitable for this application. Figure 3.2 shows a typical construction schematic for these existing wells. Additional details on the *in situ* respiration test are found in Section 5.7 of the protocol document.

3.1.1 Vapor Monitoring Point Installations

A typical multi-depth vapor MP installation for this site is shown in Figure 3.3. Boreholes for the shallow MPs will be advanced using hand augers. The MPs will be constructed of 0.5-inch PVC casings and screens and equipped with an air-tight gas ball valve in a flush-mount manhole. The feasibility of using multi-depth screens for each MP will be determined by site conditions encountered during the MP installation. Both the water table depth and the relative depth of fuel contamination are factors in placing the MP screened intervals. If the water table is greater than about 6 feet bgs, one or more MPs will be constructed using multi-depth screened intervals as shown in Figure 3.3. If the water table is less than 6 feet bgs, a single MP screen may be installed approximately 1 to 2 feet above the water table surface.

Soil gas oxygen and carbon dioxide concentrations will be monitored at the final screened interval at each MP location. Multi-depth monitoring, if applicable, will confirm that the entire soil profile is receiving oxygen and will be used to measure fuel biodegradation rates at both screened depths. The annular space between multi-depth screens will be sealed with bentonite to isolate the monitoring intervals. Data from the background vapor monitoring point will also be used to determine the relative natural diffusion of atmospheric oxygen into the shallow soils. Additional details on vapor monitoring point construction are found in Section 4 of the protocol document.



Notes:

1. Construction schematic is typical for all monitoring wells (MW-1 through MW-8) at Building 818.

2. Water table surface averages 6' below land surface.

Source: PetroChem Recovery Services (1993)

Construction Schematic for Groundwater Monitoring Wells

Building 818
Langley AFB
Hampton, Virginia

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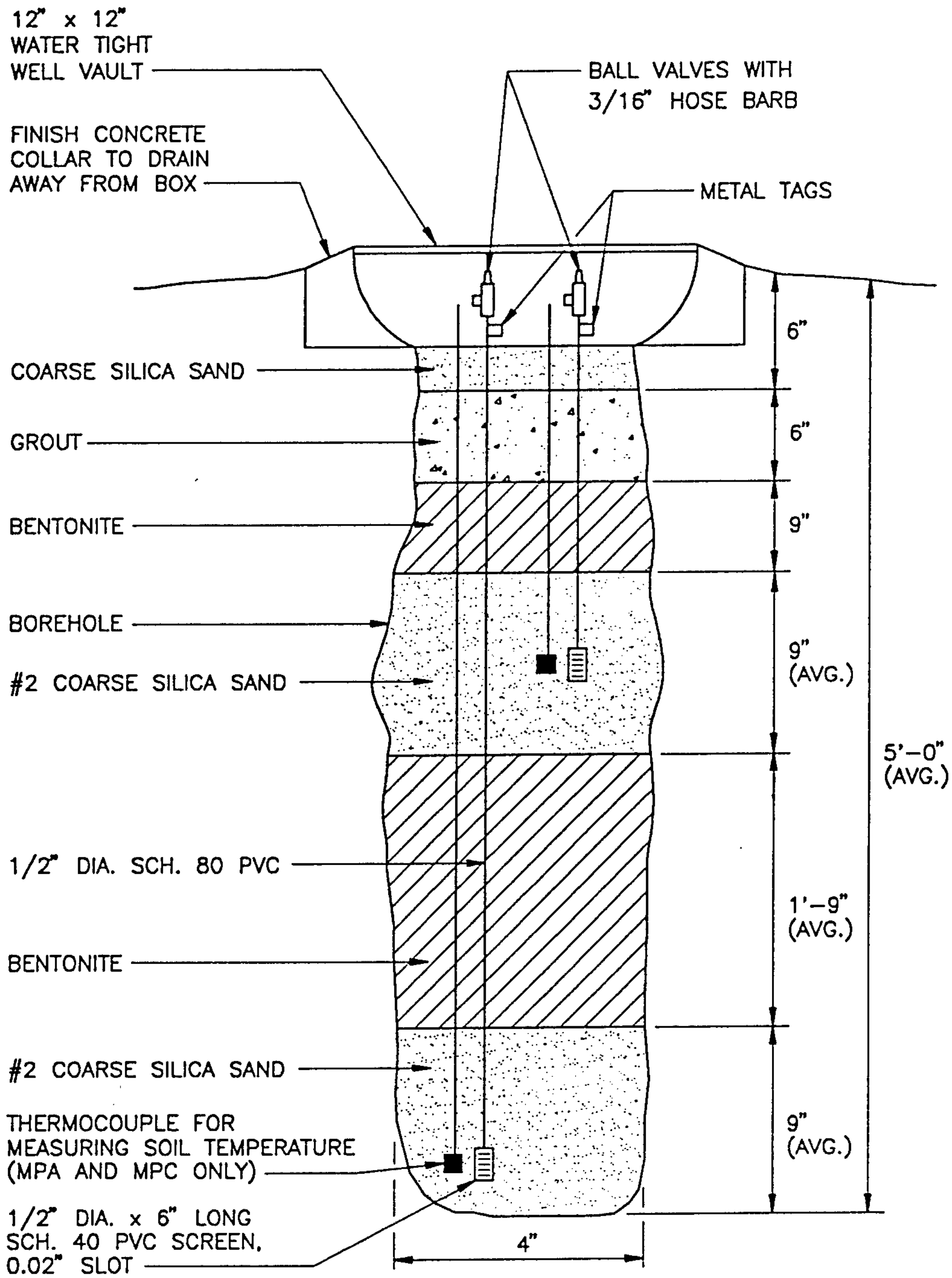

DRAWING IS NOT TO SCALE

Note:

1. Final depths of monitoring point screens will depend on water table depth at time of installation. Multi-depth screens may not be installed at each monitoring point location.

Typical Monitoring Point Construction Detail

Building 818
Langley AFB
Hampton, Virginia

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3.1.2 Vent Well Installations

Both the horizontal air injection vent well and the horizontal SVE vent well will be constructed of 4-inch (nominal I.D.) Schedule 40 PVC, with 20 feet of 0.02-inch slotted "high-yield" screens. The air injection vent well will be set in a narrow trench (12 to 18 inches wide) at approximately 5 feet bgs, while the SVE vent well will be similarly constructed in a narrow trench at a maximum depth of 4 feet bgs. The "high-yield" well screens have more open area per linear foot than conventional monitoring well screens, thereby reducing backpressure head losses and improving air exchange with the formation. Uncontaminated soils in the upper 2 feet of each trench will be segregated on-site for use as clean surficial backfill.

A 5-foot PVC casing will extend horizontally beyond each vent well screened section, followed by a PVC elbow and a 4-inch vertical PVC riser pipe. Flush-threaded PVC casings and screens will be used for vent well construction up to the header pipe connection. A filter pack of coarse #2 silica sand will be placed entirely around the screened interval to form a gravel envelope. The trench will then be backfilled with the excavated residual soil and compacted to increase the soil density of this zone. The top 2 feet of the trench excavation will be backfilled with the uncontaminated soil underlain by a powdered bentonite layer and 6-mil polyethylene plastic. The bentonite and plastic seal near the trench surface will minimize short-circuiting of injected air to the surface via disturbed soils in the trench excavation zone. Each vent well will be connected to an individual 2-inch header pipe placed in a shallow, subsurface utility trench up to the blower shed. Figures 3.4 and 3.5 illustrate the proposed air injection and SVE vent well constructions, respectively, for this site.

3.2 Handling of Waste Soils and Recovered Liquids

Contaminated cuttings from all soil borings and any remaining waste soils will be collected in a DOT-approved 55-gallon metal drum. The drums will be labeled and then placed in a designated Langley AFB waste material storage area. These waste soils will become the property of Langley AFB and will be analyzed, handled, and disposed of in accordance with the current base procedures for ongoing remedial investigations. This project is expected to generate less than one 55-gallon drum of waste soils since most of the soils can be recompacted into the trenches as backfill.

An optional liquid knock-out tank may be installed on the vacuum side of the blower. The SVE system will tend to collect vapor-entrained liquids that will condense and coalesce within the liquid knock-out tank. Although the SVE system will be operated at a low vacuum to minimize liquid recovery, some liquid recovery (i.e. soil moisture and condensed fuel) may occur in small quantities. Recovered liquids will be drained from the knockout tank and stored in an approved container at an area designated by the base. Final disposal of the liquid wastes will be performed in accordance with current base procedures for ongoing remedial investigations.

3.3 Soil and Soil Gas Sampling

3.3.1 Soil Sampling

Three soil samples will be collected from the pilot test area during the installation of the horizontal vent wells and MPs. Sampling procedures will generally follow those outlined in the protocol document, with minor modifications for collecting samples

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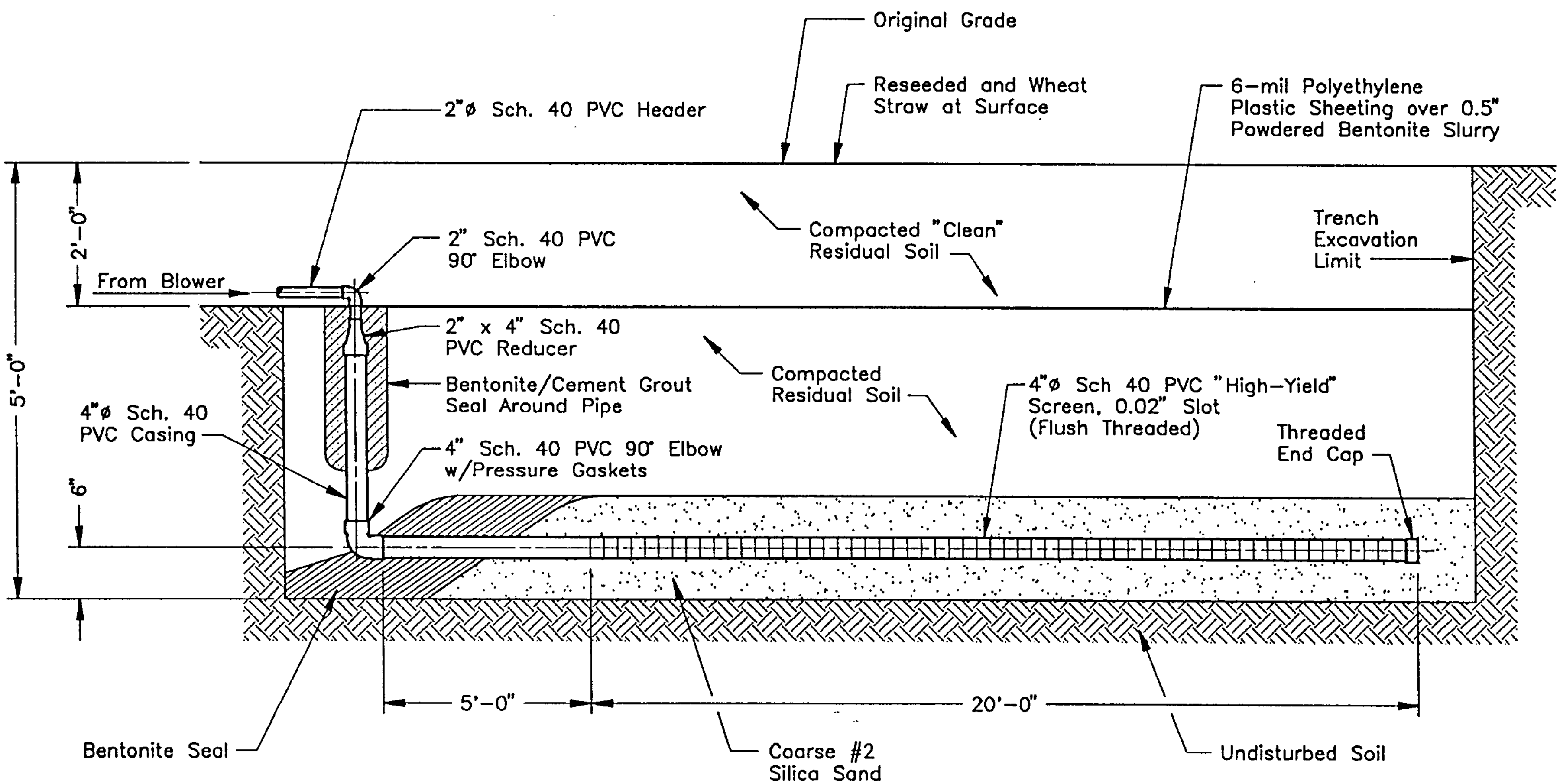

Notes:

1. Drawing is not to scale.
2. Water table was reported at approximately 6' below land surface on July 29, 1993.

Injection Vent Well and Trench Construction

Building 818
Langley AFB
Hampton, Virginia

Figure 3.4

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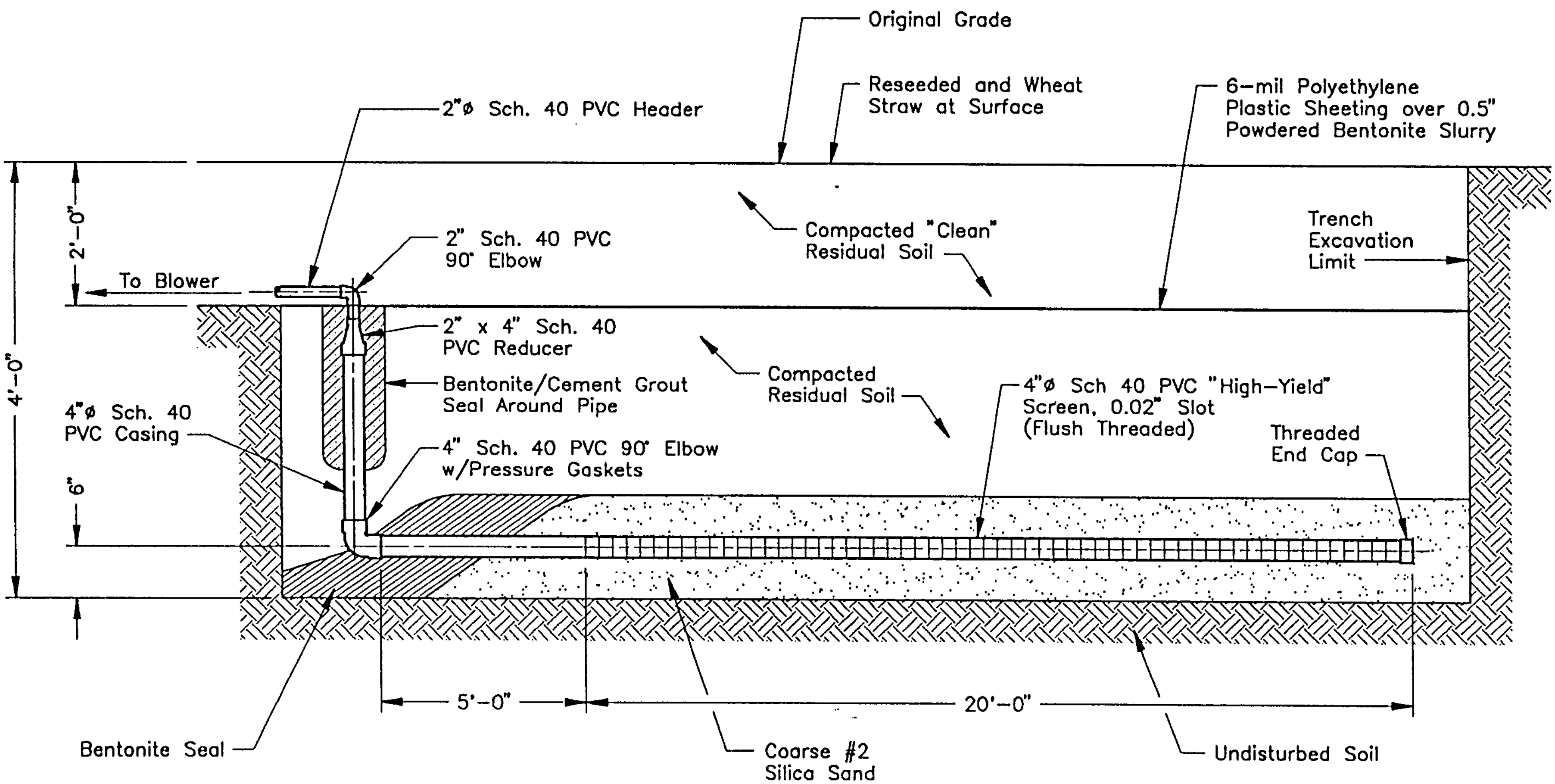

Notes:

1. Drawing is not to scale.
2. Water table was reported at approximately 6' below land surface on July 29, 1993.

Soil Vapor Extraction Vent Well and Trench Construction

Building 818
Langley AFB
Hampton, Virginia

Figure 3.5

using a hand auger in lieu of a split spoon or Shelby tube sampler. One of the soil samples will be collected from the most contaminated interval of one vent well. Additionally, one soil sample will be collected from the interval of highest apparent contamination in two of the borings for the MPs. Soil samples will be analyzed for TRPH, BTEX, soil moisture, pH, particle sizing, alkalinity, total iron, total Kjeldahl nitrogen (TKN), and phosphates. A sample will also be collected from uncontaminated soils at the background MP for TKN analysis.

Samples will be collected from the MPs by hand augering to the desired sampling depth and transferring the soil sample directly from the hand auger bucket to the sample jars. A PID or total hydrocarbon vapor analyzer (see protocol Section 4.5.2.) will be used to insure that breathing zone levels of volatiles do not exceed 1 part per million by volume (ppmv) while conducting soil borings and to screen soil samples for relative fuel contamination. Soils from the most contaminated interval of the MPs and vent wells will be submitted for laboratory analyses. Soil samples will be labeled following the nomenclature specified in the protocol document (Section 5.5), wrapped in protective plastic, and placed in an ice chest for shipment. A chain of custody form will be filled out and the ice chest shipped to PACE Laboratory in Huntington Beach, California for analysis. This laboratory has been audited by the U.S. Air Force and meets all quality assurance/quality control and certification requirements for the State of California.

3.3.2 Soil Gas Sampling

A total hydrocarbon analyzer (see protocol document, Section 4.5.2) will be used during trenching and hand augering to screen sample intervals for fuel contamination. Once the MPs are installed and adequately purged, soil gas samples will be collected using SUMMA canisters. Three SUMMA canister soil gas samples will be collected, one from the most contaminated vent well and one each from the MPs closest to and furthest from the most contaminated vent well. Quantitative soil gas samples will be used to predict potential air emissions, to determine the reduction of BTEX and total volatile hydrocarbons (TVH) during the extended test, and to detect potential migration of these vapors from the source area.

Soil gas samples will be placed in a small box and packed with foam pellets for protection during shipment. Samples will not be placed on ice to prevent condensation of hydrocarbon compounds. A chain-of-custody form will be completed and shipped with the samples to the Air Toxics, Inc. laboratory in Folsom, California. The soil gas samples will be analyzed for BTEX compounds and TVH.

3.4 Blower System

The permanent blower system used for extended testing at the site will likely consist of a 1-HP Gast Model R4110-2 regenerative blower equipped with an explosion-proof motor and starter. The blower will be installed in a locking, weatherproof box surrounded by a 6-foot wooden privacy fence with a locking gate. The purpose of the privacy fence is to maintain the aesthetics of the residential neighborhood, as well as to prevent uncontrolled access to the blower box, electrical circuit breaker, and blower exhaust stack. A noise-dampening muffler will be installed on the blower exhaust stack to reduce excessive noise from the pressure relief valve. Figure 3.6 shows a schematic of the blower system.

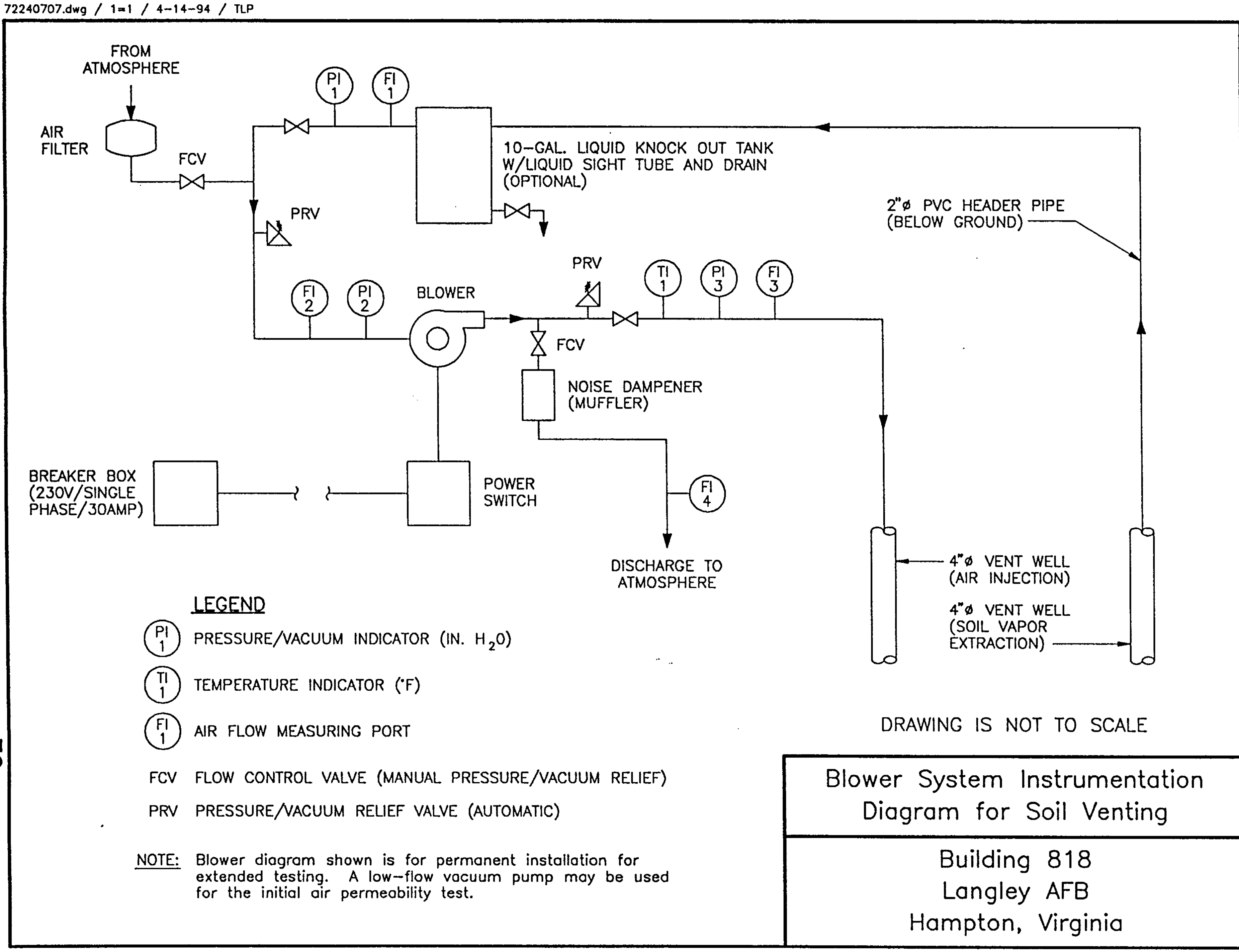
72240707.dwg / 1=1 / 4-14-94 / TLP
FROM ATMOSPHERE
AIR FILTER
FCV
PRV
PI 1
FI 1
10-GAL. LIQUID KNOCK OUT TANK W/LIQUID SIGHT TUBE AND DRAIN (OPTIONAL)
2"ø PVC HEADER PIPE (BELOW GROUND)
FI 2
PI 2
BLOWER
PRV
TI 1
PI 3
FI 3
FCV
NOISE DAMPENER (MUFFLER)
BREAKER BOX (230V/SINGLE PHASE/30AMP)
POWER SWITCH
FI 4
DISCHARGE TO ATMOSPHERE
4"ø VENT WELL (AIR INJECTION)
4"ø VENT WELL (SOIL VAPOR EXTRACTION)
LEGEND
PI 1 PRESSURE/VACUUM INDICATOR (IN. H_2O)
TI 1 TEMPERATURE INDICATOR (°F)
FI 1 AIR FLOW MEASURING PORT
FCV FLOW CONTROL VALVE (MANUAL PRESSURE/VACUUM RELIEF)
PRV PRESSURE/VACUUM RELIEF VALVE (AUTOMATIC)
NOTE: Blower diagram shown is for permanent installation for extended testing. A low-flow vacuum pump may be used for the initial air permeability test.
DRAWING IS NOT TO SCALE
Blower System Instrumentation Diagram for Soil Venting
Building 818
Langley AFB
Hampton, Virginia

Figure 3.6

The maximum power requirement anticipated for this pilot test is a 230-volt, single-phase, 30-amp service. The blower will be wired to a 230-volt, single-phase circuit breaker with two standard 110-volt receptacles. In the event that 230-volt power is not available, the blower can be wired to 115-volt, single phase, 30-amp service. Additional details on power supply requirements are described in Section 5.0, Base Support Requirements. Although fuel oil vapors are non-explosive, it is ES policy that the blower motor and starter be explosion proof on SVE systems. Additionally, the cable running to the outlet near the breaker box will be explosion proof. The breaker box shall be located 5 feet above the ground surface so that all non-explosion proof connections are above the hazardous area. A qualified electrician will complete these explosion-proof connections.

If electrical power is not readily available for installation and operation of the permanent blower, a 1-HP vacuum blower (Gast model 2067-P106) capable of injecting 16 scfm at 2 psi will be used to inject air for the initial air permeability test. Initial testing may demonstrate that less pressure and air flow is required to supply oxygen throughout the test area soil column, in which case a smaller blower may be installed for extended testing.

3.5 *In Situ* Respiration Tests

The objective of the *in situ* respiration tests is to determine the rate at which indigenous soil bacteria will degrade petroleum hydrocarbons when stimulated with oxygen-rich soil gas. Respiration tests will be performed at every MP where bacterial biodegradation of hydrocarbons is indicated by low oxygen levels and elevated carbon dioxide concentrations in soil gas. Air will be injected into each MP screened interval containing low levels (<10 percent) of oxygen. A 10 to 15 hour injection period will be used to completely oxygenate the surrounding contaminated soils. If the initial oxygen concentration at the background MP is less than 18 percent, air will also be injected into this MP to determine if non-fuel or abiotic oxygen uptake is a factor at this site. During the air injection process, a 4 to 6 percent mixture of inert helium will be injected into the MPs to use as a tracer for potential MP leaks.

At the end of the air injection period, the air supply will be cut off, and oxygen, carbon dioxide, TVH, and helium concentrations will be monitored at regular intervals for the following 24 to 48 hours. The respiration test will continue until oxygen levels have declined at least 5 percent or, if time permits, until all of the oxygen is consumed. The decline in oxygen and increase in carbon dioxide concentrations measured during the respiration tests will be used to estimate rates of bacterial degradation of TPH in the soils.

3.6 Air Permeability Test

The objective of the air permeability test is to determine the extent that the subsurface can be oxygenated using one air injection vent well. Air will be injected into the 4-inch air injection vent well using the blower unit. Pressure responses will be measured at each MP and the surrounding monitoring wells using Magnehelic and/or digital manometer pressure gauges. Oxygen will also be monitored in the MPs to determine the radius of oxygen influence achieved during air injection. The air permeability test is expected to last between 2 to 4 hours.

The SVE vent well will not be operated during the initial phases of the air permeability test. Once steady-state pressure conditions are achieved and soil oxygen levels increase in the outer MPs, the SVE vent well will be attached to the vacuum side of the blower. The SVE and air injection vent wells will then be operated simultaneously to simulate the "closed loop" operating condition. Adjustments will be made to optimize and balance the system for extended testing. Soil pressures and oxygen concentrations will continue to be measured throughout the system adjustment period. An ideal air injection/SVE system balance will be achieved when the net pressure response at the central vapor monitoring point (MPB) is approximately zero and the air injection flow rate approximately equals the SVE flow rate.

3.7 Air Emissions and Site Monitoring

As previously discussed, Building 818 is located in a populated residential area. Health and safety concerns associated with bioventing this site include potential vapor emissions from the ground surface and controlling vapor accumulation in the adjacent basement. The bioventing system will be designed to control vapor migration to the extent practical by incorporating the SVE component and by using low air injection rates.

A site monitoring program will be implemented during the initial bioventing tests. Ambient air quality will be monitored in the basement of Building 818 using a total hydrocarbon analyzer prior to and during the air permeability tests. Pretest air quality results will be compared to air quality results measured during air injection to determine if injecting air into the subsurface forces contaminated soil vapors into the basement. Basement air quality measurements will also be made under various SVE flow rates to determine the effectiveness of the SVE system to reduce hydrocarbon vapors in the vicinity of the Building 818 basement.

Fugitive vapor emissions from air short-circuiting at the ground surface are another concern since the site is located in a yard accessible to base housing residents. Using test procedures developed by the United States Environmental Protection Agency (USEPA, 1986), an emissions flux chamber will be installed on the ground surface to monitor changes in ambient air quality at the ground surface. The flux chamber consists of a metal or plastic container of known volume that is sealed at the ground surface. The device contains air sampling ports to collect ambient air samples from within the sealed chamber. As air is injected into the subsurface, fuel vapors escaping from the ground surface are trapped within the chamber. Air samples collected from the chamber are measured using field instruments and/or by quantitative laboratory analysis. The degree of air quality degradation within the chamber indicates the magnitude of vapor emissions over a known surface area. Flux chamber monitoring will be conducted throughout the air permeability test to optimize the system operation.

Air emissions from the blower exhaust will also be measured during the SVE portion of the air permeability test. Site conditions may prevent reinjection of all soil gas extracted via the SVE vent well. In this case, some of the extracted soil gas will be vented to the atmosphere. Air sampling of TVH will be performed with a total hydrocarbon analyzer both at the blower exhaust stack and in the breathing zone near ground level.

4.0 EXCEPTIONS TO PROTOCOL PROCEDURES

The procedures that will be used to measure the air permeability of the soil and *in situ* respiration rates are described in Sections 4 and 5 of the protocol document. Several deviations from the established protocol are anticipated. The only foreseen exceptions to field testing protocol procedures are the possible use of existing wells for use as a vapor monitoring point or as a background monitoring point.

Another exception to typical procedures in the protocol document is the installation of horizontal vent wells and simultaneous operation of the vent wells in a "closed loop" air injection/vapor extraction system. This deviation from standard vertical vent well design and operation is necessary to maximize the physical soil venting process and the ultimate success and safety of the bioventing test. Current site conditions do not support the use of vertical vent wells, as this type of well construction would most likely result in short-circuiting of air with the surface. Installation of horizontal vent wells will require excavation with a backhoe equipped with a narrow (18 inch) bucket. A drilling contractor will not be needed for this site.

Soil borings for vapor monitoring point installations will be advanced using a hand auger at this site. Since a drill rig will not be used, the typical borehole diameter for each monitoring point will be approximately 4 inches, as illustrated in Figure 3.3.

5.0 BASE SUPPORT REQUIREMENTS

5.1 Test Preparation

The following base support is needed prior to the arrival of an excavation contractor and the Engineering-Science test team:

- Confirmation of regulatory approval for the pilot tests.
- Assistance in obtaining a digging permit at the bioventing sites.
- A breaker box mounted to a temporary utility pole on each test site which can supply 230-volt, single-phase, 30-amp electrical service. Alternatively, the blower can be powered by 115-volt, single-phase, 30-amp electrical service if 230-volt service is not readily available at the site. The circuit breaker box should be located five feet above the ground and should include two 110-volt receptacles to support ancillary testing equipment.
- Provide any paperwork required to obtain gate passes and security briefings for approximately three Engineering-Science employees and three excavation contractors. Vehicle passes will be needed for three trucks.

During the initial two-week pilot test the following base support is needed:

- Twelve square feet of desk space and a telephone in a building located as near to the site as practical.
- A decontamination area where the excavation contractor can clean the backhoe bucket.
- Accept responsibility for soil cuttings from vent well trenches and monitoring point borings including any drum sampling to determine hazardous waste status.

- The use of a fax machine for transmitting 15 to 20 pages of test results.

During the one-year extended pilot tests:

- Check the blower system at the site once a week to ensure that it is operating and to record the air injection pressure and SVE vacuum. Engineering-Science will provide a brief training session and an O&M checklist for this procedure. Local support for system O&M may be provided by an ES employee currently assigned to a long-term project at the base.
- Notify Mr. Grant Watkins, Engineering-Science, Inc., Cary, North Carolina (919) 677-0080; or Mr. Doug Downey, Engineering-Science, Inc. Denver (303) 831-8100; or Lt. Maryann Jenner of AFCEE (210) 536-4364 if the blower or motor stop operating.
- Arrange site access and passes for an Engineering-Science technician to conduct *in situ* respiration tests approximately six months and one year after the initial pilot test.

5.2 Regulatory Approval

Base personnel are responsible for obtaining regulatory approval and permits (if required) from the Commonwealth of Virginia Department of Environmental Quality (DEQ) to perform the tests and system installations as described in this work plan. If required, Engineering-Science will assistance this effort by providing test design criteria and reference documents for regulatory review. Unless directed by AFCEE or the Langley AFB point of contact, no direct contact will be made between Engineering-Science and the regulatory agencies. ES anticipates that an air emissions permit will not be required for the bioventing tests.

6.0 PROJECT SCHEDULE

The following schedule is contingent upon timely approval of this pilot test work plan.

Event	**Date**
Draft Test Work Plan to AFCEE/Langley AFB	April 14, 1994
Approval to Proceed	April 26, 1994
Mobilization and System Installations	May 23, 1994
Begin Initial Field Tests	May 30, 1994
Complete Initial Field Tests and Begin Extended Tests	June 6, 1994
Interim Results Report	July 18, 1994
Six-Month Respiration Tests	December 1994
Final Respiration Test	June 1995

After a period of one year, a decision will be made by AFCEE and the base to either remove the system or to expand the system for full-scale remediation at the site.

7.0 POINTS OF CONTACT

Mr. John Ballinger
1st CES/CEV
Environmental Management Flight
209 Thornell Avenue
Langley AFB, Virginia 23665-2775
(804) 764-2749

Lt. Col. Ross Miller/Lt. Maryann Jenner
HQ AFCEE/ERT
8001 Arnold Drive, Bldg. 642
Brooks AFB, TX 78235-5357
(210) 536-4331/4364

Mr. Grant Watkins, P.G.
Engineering-Science, Inc.
401 Harrison Oaks Blvd., Suite 210
Cary, North Carolina 27513

Mr. Doug Downey, P.E.
Engineering-Science, Inc.
1700 Broadway
Suite 900
Denver, Colorado 80290
(303) 831-8100

8.0 REFERENCES

Environmental Technology of North America, Inc. March 24, 1994. Letter report for Building 818 UST removal from Mr. Eric Hamilton to Mr. John Ballinger, 1st CES/CEV, Langley AFB, Virginia.

Hinchee, R.E., S.K. Ong, R.N. Miller, D.C. Downey, and R. Frendt. 1992. *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing.* Prepared for Air Force Center for Environmental Excellence. May. Denver, Colorado.

PetroChem Recovery Services, Inc. *Site Characterization Report, Building #818, Langley Air Force Base, Hampton, Virginia.* September 24, 1993.

USEPA, 1986. *Measurement of Gaseous Emission Rates From Land Surfaces Using An Emission Isolation Flux Chamber.* USEPA Publication No. PB-86-223161.

ENGINEERING-SCIENCE, INC.

401 Harrison Oaks Boulevard, Suite 210 • Cary, North Carolina 27513 • (919) 677-0080 • Fax: (919) 677-0118

April 15, 1994

Lt. Maryann M. Jenner
HQ AFCEE/ERT
8001 Arnold Drive, Building 642
Brooks AFB, Texas 78235-5357

Subject: Draft Bioventing Work Plan
Building #818 UST Release Site
Langley AFB, Virginia

Dear Lt. Jenner:

Enclosed are three copies of the Draft Bioventing Work Plan for Building #818 UST release site, Langley Air Force Base, Hampton, Virginia. This Draft report serves as a site-specific addendum to the document "Test Plan and Technical Protocol for a Field Treatability Test for Bioventing."

After review by AFCEE and Langley AFB personnel, comments will be addressed and incorporated into a Final Work Plan. ES would like to begin initial testing at this site no later than the week of May 30,1994. As noted in the Draft Work Plan, the bioventing pilot study will not begin until regulatory approval is obtained.

If you have any questions concerning this work plan or the proposed testing schedule, please call me at (919) 677-0080 or Mr. Doug Downey at (303) 831-8100.

Sincerely,

ENGINEERING-SCIENCE, INC.

S. Grant Watkins

S. Grant Watkins, P.G.
Site Manager

Enclosure

cc: Mr. John Ballinger (Langley AFB)

ENGINEERING-SCIENCE, INC.

401 Harrison Oaks Boulevard, Suite 210 • Cary North Carolina 27513 • (919) 677-0080 • Fax: (919) 677-0118

April 15, 1994

Mr. John Ballinger
Environmental Management Flight
1st CES/CEV
209 Thornell Avenue
Langley AFB, Virginia 23665-2775

Subject: Draft Bioventing Work Plan
Building #818 UST Release Site
Langley AFB, Virginia

Dear Mr. Ballinger:

Enclosed are three copies of the Draft Bioventing Work Plan for Building #818 UST release site, Langley Air Force Base, Virginia. This Draft report serves as a site-specific addendum to the document "Test Plan and Technical Protocol for a Field Treatability Test for Bioventing."

After review by AFCEE and Langley AFB personnel, comments will be addressed and incorporated into a Final Work Plan. ES would like to mobilize to the site to begin system installations no later than the week of May 23, 1994. As noted in the Draft Work Plan, the bioventing pilot study will not begin until regulatory approval is obtained. Therefore, the base should forward a copy of this work plan to the Virginia DEQ as soon as possible to initiate the regulatory approval process.

If you have any questions concerning this work plan or the proposed testing schedule, please call me at (919) 677-0080 or Mr. Doug Downey at (303) 831-8100.

Sincerely,

ENGINEERING-SCIENCE, INC.

S. Grant Watkins

S. Grant Watkins, P.G.
Site Manager

Enclosure

cc: Lt. Maryann Jenner (AFCEE-Brooks AFB)